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Environmental Effects of Dredging Technical Notes



FACTORS INFLUENCING BIOACCUMULATION OF SEDIMENT-ASSOCIATED CONTAMINANTS BY AQUATIC ORGANISMS; GLOSSARY AND BIBLIOGRAPHY

PURPOSE: This is the fourth technical note in a series of four which outlines and describes the principal factors that determine uptake and retention of chemicals by aquatic organisms. The first three notes in the series describe factors relating to contaminants, sediment and water, and biota. This note contains a glossary of terms and a bibliography of key and recent publications in the scientific literature containing supporting data and discussion on each topic. The information contained herein is intended to assist Corps of Engineers environmental personnel in activities requiring a working knowledge of concepts and terminology in the subject of chemical uptake, retention, and elimination by aquatic organisms exposed to contaminated sediments.

BACKGROUND: Bioaccumulation is the general term used to refer to the uptake and storage of chemicals by organisms from their environment through all routes of entry. Bioaccumulation includes bioconcentration, which is the direct uptake of chemicals from water alone, and is distinguished from biomagnification, which is the increase in chemical residues taken up through two or more levels of a food chain. Assessments of the potential for bioaccumulation of toxic substances associated with dredged sediments are often required in evaluations of permit requests. Thus, familiarity with the fundamental physical, biological, and chemical factors affecting bioaccumulation is necessary for performing evaluations of the ecological impacts of dredging operations. Additionally, a basic understanding of the concepts and terminology of bioaccumulation is increasingly required of environmental personnel who are involved in dredging and disposal operations which may involve contaminated sediments and legal personnel involved with regulation and litigation.

These notes are intended to serve as a source of basic information and to provide a guide to the scientific literature for each topic discussed. The emphasis is on factors affecting bioaccumulation of sediment-associated chemicals. A brief discussion of each factor is given and a list of references is provided. The references are extensive and frequently bear on more than one topic. An effort has been made to select both historically important works and the most recent research reports in each area. Numbers in parentheses following the subject headings locate the references for each subject. Papers referenced are alphabetized for each subject for each identification of those most pertinent to the reader's interest.

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The subjects discussed in these notes reflect current research for which new findings constantly appear in the literature. Consequently, the discussions and interpretations are based on inference and best judgment regarding the interactions of factors influencing bioaccumulation and represent the best understandings of the authors. Readers are encouraged to consult the literature cited.

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Glossary

Absorption: assimilation of a chemical into biological tissue by capillary, osmotic, chemical, or solvent action.

Adsorption: condensation of gases, liquids, or dissolved substances on the surfaces of solids.

Assimilation efficiency: speed and effectiveness with which a chemical in food is incorporated into the tissues of an organism.

Bilipid: membrane formed of two separate sheets of lipid molecules which orient themselves so that the polar headgroups are exposed to the outer aqueous environment and the nonpolar tails are exposed to each other.

Bioaccumulation potential: equilibrium concentration of a foreign compound that could result in an organism's tissues given unlimited time and an absence of degradative and gradient effects.

Bioavailability: extent to which the fraction of the total chemical in the environment is available for uptake by an organism.

Biphasic: having two separate and distinct stages or periods.

Body burden: total concentration of a chemical in an organism taken up from the environment.

Cation: positively charged ion.

Cationic exchange capacity: extent to which negatively charged groups of a sediment matrix are able to exchange one cation for another.

Coprecipitate: inclusion of ions in a precipitation reaction by physical association rather than chemical bonding.

Complexation: bonding of metal ions with organic molecules.

Conjugation: addition reactions in which large chemical groups or entire compounds such as sugars and amino acids are covalently added to endogenous or foreign organic chemical compounds in metabolic detoxication.

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